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Environmental resources as 'last resort' coping strategies following harvest failures in Zimbabwe

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ABSTRACT

Environmental resources are often cited as important for households coping with hazards in the Global South. However, a recent large-scale analysis has challenged the narrative of 'forest as safety net'. Clarifying this contradiction is important given the anticipated increase in the frequency of severe hazards due to climate change, and also because calls for habitat restoration may drive transformation of resource access in tropical landscapes. Here we examine the importance of environmental coping strategies to 85 households in Wedza District, Zimbabwe, exploring how the situation of households in different vulnerability contexts shapes dependence on environmental safety nets. We firstly compare recalled responses to two past hazard exposures, the drought of 2002 and the interacting harvest failure and hyperinflation crisis of 2008, to assess how exposure to multiple interacting hazards might alter the coping strategies available to and preferred by rural households. We secondly use scenario exercises to explore why households might or might not choose to adopt environmental coping strategies. We find that interactions between co-occurring covariate hazards can increase dependence on environmental resources by rendering preferred strategies unavailable, with the proportion of respondent households recalling dependence on environmental resources as a core strategy increasing from 31% in 2002 to more than 50% in 2008. We find also that the co-occurrence of covariate and idiosyncratic hazards, such as incapacitation of the primary income earner during a drought period, can increase dependence on environmental coping strategies. While respondents acknowledge the downsides of environmental safety nets, such as illegality, seasonality, and market unreliability, they still perceive environmental resources to be among the most important strategies. Our results demonstrate the importance of considering the whole vulnerability context when evaluating the importance of environmental coping strategies, in order to avoid underestimating the contribution made by environmental resources to the resilience of rural livelihoods.

1. Introduction

Environmental resources, particularly those from forests and woodlands, are often cited as important for coping with exposure to hazards in rural areas of the Global South (McSweeney, 2005; Fisher, Chaudhury, & McCusker, 2010; Kalaba, Quinn, & Dougill, 2013; Mugido & Shackleton, 2017). However, the first large-scale empirical analysis of environmental coping strategies (Wunder, Börner, Shively, & Wyman, 2014) has challenged this common narrative of 'forest as safety net', finding that environmental coping strategies are of limited importance compared to alternatives such as drawing on kin networks (a conclusion also supported in case studies by Zinyama, Matiza, & Campbell, 1990; Debela, Shively, Angelsen, & Wik, 2012; Weyer, Shackleton, & Adam, 2018).

The contradictory picture of environmental coping strategies found in current literature should be of concern for two reasons. The first is that climate change is anticipated to increase the frequency and severity of the hazards encountered by households in many areas of the Global South (IPCC, 2014). Understanding the climate resilience of rural social-ecological systems necessitates identifying the environmental resources used to cope with exposures, the circumstances which produce dependence on environ-

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mental safety nets, and the consequences of changes to resource extraction for the structure and functioning of ecological communities.

The second reason is that landscape restoration is gaining popularity as a 'solution' for the interlinked crises of climate change and biodiversity loss (see e.g. Bastin et al., 2019). Particular emphasis is being placed on the restoration of degraded forest landscapes, an approach exemplified in the Bonn Challenge (Bonn Challenge, 2019). Proponents of restoration often include benefits for local people among anticipated outcomes (Chazdon & Brancalion, 2019; Lewis, Wheeler, Mitchard, & Koch, 2019); but even if novel livelihood opportunities emerge for some, the process of restoration must also inevitably demand changes in the ways that land can be used. Without in-depth understanding of current local environmental resource use patterns, including during hazard exposures, changes to resource access in the name of restoration may have adverse impacts on the resilience of rural households (for an example of such a misjudgement see McElwee, 2009).

Studies exploring the reasons behind observed variation in use of environmental coping strategies have focused variously on characteristics of the household, the location, and the shock itself. Household socioeconomic characteristics are widely recognised to be important, with poor households in particular having higher dependence on environmental safety nets (Paumgarten & Shackleton, 2011; Kalaba et al., 2013). Other authors have documented geographic differences, sometimes linked to the availability of relevant resources – Wunder et al. (2014), for example, find higher dependence on environmental coping strategies in Asian as opposed to African study sites, while Eriksen and Silva (2009) demonstrate the importance of local resource availability to coping strategy choice by comparing two Mozambican villages. Analyses have also been carried out comparing coping strategies used during small-scale exposures impacting single households as compared to during regional-scale shocks impacting many households, finding environmental resources to have greater importance in the latter situation (Wunder et al., 2014).

However, in common with Eriksen and Silva (2009), we argue that household, location and shock characteristics cannot be considered alone, but that environmental coping strategies must be understood with reference to the broader vulnerability context inhabited by an individual or household (Turner et al., 2003). It is widely recognised that rural households in the Global South do not experience hazards in isolation, but are simultaneously exposed to multiple interacting hazards operating at different spatial and temporal scales (O'Brien & Leichenko, 2000; Turner et al., 2003; O'Brien, Quinlan, & Ziervogel, 2009). The coping strategies available and preferred will depend upon the precise mixture of hazards encountered in conjunction with the resources available to the household and with larger socio-political and environmental contexts (Reid & Vogel, 2006; Quinn, Ziervogel, Taylor, Takama, & Thomalla, 2011; Bennett, Blythe, Tyler, & Ban, 2016). The majority of environmental coping strategy case studies have so far engaged only with the local and have considered individual hazard types in isolation, failing to situate use of environmental coping strategies within the larger vulnerability context. This limits the extent to which it is possible to anticipate how future hazard exposures might impact environmental dependence among rural households.

An additional oversight in current environmental coping strategy literature is that few studies explore usage of environmental coping strategies following very severe hazard exposures (although for a notable exception see McSweeney, 2004, 2005). Many studies, including Wunder et al. (2014), explore coping strategy use in the year preceding the survey – this focus on a single year reduces the probability of recall errors, but (as Wunder et al. themselves acknowledge) means that results are unlikely to reflect behaviour following exposures of once-in-a-decade or once-in-a-lifetime severity. This seems a key gap in current literature, as it may result in underestimation of the importance of environmental safety nets during periods of extreme livelihood stress.

Our objective in this paper is therefore to explore the extent to which interacting and/or severe hazard exposures promote dependence on environmental coping strategies through an in-depth mixed-methods case study of 85 households in rural Zimbabwe. We firstly explore household coping strategies during two past hazard exposures, the drought of 2002 and the co-occurring harvest failure and hyperinflation crises of 2008. We further draw upon scenario exercises and household case studies to investigate why households may or may not become dependent upon environmental coping strategies during exposures. Through this analysis we aim to improve understanding of the contribution made by environmental resources to the resilience of rural livelihoods in Zimbabwe.

2. Methods

In this section, we firstly define the key terms used in the study, before providing a description of the study location. We then outline the methods used to ascertain coping strategies used during past hazard exposures and to elicit the motivations behind coping strategy choices.

2.1. Key definitions

While households in uncertain environments often exhibit preemptive livelihood adaptations such as livelihood diversification in anticipation of probable hazard exposures (Kinsey, Burger, & Gunning, 1998; Ellis, 2000), our primary focus in this study is on the reactive coping strategies adopted during and immediately following exposure. Bennett et al. (2016; 909) define coping strategies as 'short-term reactive or unplanned responses to moderate the impact of, or sensitivity to, exposures.' Coping strategies will vary with the characteristics of the hazard exposure, for example the severity and duration of the exposure, and also whether the exposure is covariate (impacting all households within a designated region) or idiosyncratic (impacting only single individuals or households; terms follow Baulch & Hoddinott, 2000; Dercon, 2002).

The majority of published studies on environmental coping strategies focus particularly on forest resources and non-timber forest products (e.g. McSweeney, 2004; Paumgarten & Shackleton, 2011; Kalaba et al., 2013). However, in this particular study context focusing only upon resources from woody ecosystems would provide a blinkered view of coping strategy behaviour, firstly because many non-cultivated resources of livelihood importance in the area are derived from non-wooded land, and also because small-scale gold mining plays an important role in rural livelihood strategies (Pritchard, Grundy, van der Horst & Ryan, 2019). We therefore follow Cavendish (2000) in adopting a broader definition of environmental resources and consider all coping strategies based on collection of wild-sourced organic and mineral resources within our analysis.

2.2. Study site

The research underpinning this paper was carried out in Wedza Communal Area, in the Mashonaland East province of Zimbabwe. Communal areas exist as a consequence of colonial-era land governance patterns in Zimbabwe, when African farming was concentrated in reserve areas initially established following the first *chimurenga* (uprising against colonial rule) in 1897 (Chimhowu & Woodhouse, 2008). Wedza Communal Area is situated on and

around the Wedza Mountain range, which has retained cover of high biomass savanna woodland while the surrounding lowlands have become largely deforested and the land more intensively used (Gumbo, 1988; Pritchard, Ryan, Grundy & Van der Horst, (2018).

We originally chose the six study villages as part of a project exploring links between woodland cover and household environmental income, and the villages are therefore situated at various points on a gradient of woodland resource availability (fuller details can be found in (Pritchard, Ryan, van der Horst & Grundy, 2018; Pritchard, Grundy, van der Horst & Ryan, 2019)). Two of the villages, Makumbe and Pfende, are located in the deforested lowlands to the west of the mountain, close to the tarred road which runs between the small towns at Wedza and Sadza. Mapfanya and Betera villages are also to the west of the mountain and lie adjacent to the less disturbed mountain woodlands, while Charambira and Mbizi are located on the less easily accessible eastern side of the mountain, between the mountain woodland and the Save River. Additional to woodland resource availability, villages also exhibit variations in access to water resources (there are no permanent streams or rivers in Mapfanya or Betera) and in access to mineral resources (small-scale gold mines on Wedza Mountain are an important income source for residents of Mapfanya and Mbizi). While all lying within a 7 km radius of the Gandamasungo peak of Wedza Mountain, the study villages therefore represent a range of social-ecological contexts.

Village land comprises a mixture of land used by individual families (active fields, vegetable gardens and a small number of private woodlots) and common property land including woodlands and seasonal wetlands. All village residents can collect environmental resources from and graze livestock in common property areas. Extended kin networks often also facilitate use of common property resources in adjacent villages, as observed by Mandondo (2001). Some environmental resources, such as some wild fruits or edible insects, can be gathered without restrictions from land farmed by other families, but collecting larger items such as fresh wood or thatching grass would require the permission of the primary land-user. The cutting of any significant number of trees for firewood or construction is not technically permitted, but customary and legal restrictions are poorly enforced so that cutting of fresh wood was widely observed in the study area. Consumption and sale of environmental resources such as firewood, wild foods and construction materials accounts for around 30% of total household income (Grundy, van der Horst & Ryan, 2019), consistent with other studies in Zimbabwe (Cavendish, 2000) and sub-Saharan Africa (Mamo, Sjaastad, & Vedeld, 2007; Angelsen et al., 2014). Farming, livestock, piecework, small-scale gold mining and remittances from relatives are also important components of livelihoods in the study area.

The vulnerability context of rural livelihoods in Wedza District has changed dramatically in recent years, mirroring the political and economic upheaval in Zimbabwe as a whole. The Zimbabwean economy declined steeply during the 2000s, coinciding with a period of fast-track land reform partially motivated by inequities in land ownership remaining from the colonial era. While the costs and benefits of fast-track land reform for the rural poor are the subject of continued debate (Scoones, 2010, 2015; Moyo, 2013), one outcome is that the appropriation of the large farms surrounding Wedza Communal Area and the closure of businesses due to the economic downturn has resulted in a reduction in the wage labour opportunities available to communal area residents.

The declining economy was also associated with the weakening of the Zimbabwe dollar, culminating in a period of hyperinflation which coincided with a harvest failure in 2008. This co-occurrence of economic and climatic shocks left an estimated 5.5. million Zimbabweans in need of food assistance in 2008 (USAID, 2009), but the provision of international support was hampered by government restrictions on aid agency activity in the country for much of 2008 (Black & McGreal, 2008) and by political turmoil following the disputed 2008 elections. The hyperinflation crisis also resulted in many communal area residents losing their savings or their access to pension income.

Households in Wedza District are exposed to numerous other hazards within this evolving economic context. The onset of rainfall is locally perceived as having become increasingly variable, and even since the commencement of this project in 2013 study households have experienced substantial crop losses to both drought and localised flooding. Additional covariate hazards include market volatility and failures in local and national infrastructure such as roads and communication networks. We also observed a high incidence of idiosyncratic health shocks while in the study area, exacerbated by the limited availability and relatively high cost of quality healthcare.

The core data collection for this study was carried out between 2014 and 2016, during which time the country was experiencing a period of relative economic stability following the adoption of the US dollar to replace the collapsed Zimbabwe dollar. However, at the time of writing the economy has declined again, and the country is currently experiencing a cash shortage as well as shortfalls in key resources such as fuel, groceries and medicines. A poor harvest in combination with the above economic challenges is resulting in widespread food insecurity (FEWS NET, 2019). Understanding the coping strategies used in past hazard exposures is particularly important given this continuing context of uncertainty faced by rural Zimbabwean households.

2.3. Data collection

The majority of the analysis in this paper is based on two data sets: recall of responses to two past exposures, and a scenario exercise weighting potential coping strategies in response to different hazard exposure scenarios. These two sets of questions were appended as a module in the February/March 2015 round of an ongoing household environmental income survey (full details provided in (Pritchard, Grundy, van der Horst & Ryan, 2019)). The February/March survey round included 96 households, with survey households having been selected using random sampling stratified by household size and gender of household head, as these two variables have previously been observed to be linked to variation in dependence on environmental resources (Angelsen et al., 2014). Sample households were distributed across study villages proportionally to the number of currently inhabited households in each village, established using participatory mapping and focus group discussions at the outset of fieldwork.

Questions on coping strategies were initially trialled in two households outside the main sample, but early in the full survey it became apparent that there were some inconsistences in scenario presentations. Scenario descriptions were therefore adjusted based on feedback from early respondents and the first 11 households were excluded from the analysis. This gave a total sample of 85 households, accounting for 43% of inhabited households across the six study villages.

We firstly focused on coping strategies in two hazard exposure contexts, those of 2002 and 2008. Widespread crop failure followed a severe drought between January and March in 2002, with an estimated 6 million Zimbabweans having insufficient production and income to meet their food needs (FAO/WFP, 2002). The economy was also beginning to decline, with annual inflation rates of around 200 percent (The New Humanitarian, 2003). The failure of the harvest in 2008, however, coincided with the peak of the hyperinflation crisis – the estimated annual rate of inflation in June 2008 was around 2.5 million percent (Hanke, 2008). Households

were therefore forced to cope with two simultaneous and severe covariate hazards.

We used open-ended questions to understand the coping strategies used in 2002 and 2008. Our primary motivation in using this technique rather than a pre-coded questionnaire which would have enabled a larger sample size was that we wished to avoid leading respondents into identifying environmental resources as important – an issue identified by Wunder et al. (2014) as occurring in numerous previous studies and potentially skewing the literature in favour of environmental coping strategies. The responses to these questions provided information both about the responses of individual households and about the vulnerability context faced within Wedza Communal Area in 2002 and 2008.

In the second part of the module we outlined three potential hazard exposure scenarios (Table 1), all of which had been reported by respondents as occurring in the area during an earlier period of fieldwork from April to September 2014. While part of our interest is in whether interactions between co-occurring hazards can produce increased environmental dependence, it became apparent during initial survey trials that it would be challenging to present a scenario involving multiple co-occurring hazards and that respondents were likely to interpret such a complex scenario in different ways, meaning that responses would not be comparable. We therefore presented the three hazard scenarios sequentially, focusing on only one hazard in each scenario. We were however able to link scenario responses to our broader understanding of household vulnerability context gained through the co-occurring household income survey.

For each hazard exposure scenario respondents were presented with cards showing eleven potential coping strategies (Table 2) derived from previous studies also carried out in Wedza District (Kinsey et al., 1998; Woittiez, Rufino, Giller, & Mapfumo, 2013) and from consultation with local residents during the earlier fieldwork period in the study area. Respondents were given 20 beans and asked to distribute them across the eleven potential coping strategies proportional to the perceived importance of the strategy in each exposure scenario. This technique is based on approaches used in participatory rural appraisal (Chambers, 1994) and was chosen because co-creation of a visual object can help reduce the power imbalance between interviewer and interviewee and result in discussions revealing data which might not be obtained from a simple open-ended question. Once the respondent was happy with the distribution of beans for the given scenario they were asked follow-up questions to establish the reasoning behind the distribution. The exercise was facilitated in Shona (the local language) by N. Dzobo, an experienced local researcher, who also translated respondent explanations in situ. The notes taken on the explanations given by respondents became the basis for additional qualitative analysis of the motivations underpinning coping strategy choice.

The 'formal' survey methods described above were also complemented by data gained through participant observation and through continued research and social interactions with respondents during the study. R. Pritchard maintained detailed field notes during the total of ten months spent living in the study area between October 2013 and December 2015, and N. Dzobo is a permanent resident of one of the study villages, meaning that we were able to draw on a substantial body of contextual observational data to triangulate interview responses. These data, in combination with the survey data, also allowed us to construct a number of case studies of households with particularly high reliance on environmental coping strategies, and thereby to gain increased insight into the factors which might promote reliance on environmental safety nets.

Both recall data and scenario exercises are potentially vulnerable to biases, for example due to inaccuracies in remembered behaviour and because respondents might attempt to give 'correct' answers based upon their perception of what the interviewer wants to hear. The use of open-ended questions to understand recalled coping strategies also means the responses given are likely to reflect the coping strategies perceived as most important by respondents, rather than the full portfolio of responses (as households often use multiple coping strategies simultaneously or sequentially; Eriksen, Brown, & Kelly, 2005; Béné et al., 2016). We attempted to reduce the likelihood of interviewees trying to match interviewer preferences by only commencing this component of the research in the second season of data collection, having invested substantial time in trust-building between April and September 2014. We also triangulated our survey data using the observational data described above and by discussing our results with respondents in 18 feedback workshops carried out in May 2017. The similarities between different data sources, and the agreement with the core findings of our study among feedback groups, gives us greater confidence in the robustness of our conclusions. The limitations of our approaches did however produce useful lessons for future research on similar themes (see Study Limitations section in the Discussion).

Table 1
Three scenarios presented to respondents in Wedza District, Zimbabwe, and used to explore coping strategy choices.

Scenario	Exposure Type	Scale	Scenario description
1	Crop Failure	Idiosyncratic (household level)	Most of your crops are destroyed by pests like wild pigs or bushbuck, but other people in the village are not affected
2	Crop Failure	Covariate (national level)	There is a drought that impacts crop harvests in all of Zimbabwe, and all households including yours are struggling to harvest enough
3	Illness	Idiosyncratic (household level)	The main income earner in the household becomes incapacitated with a serious illness and is unable to work for several months

Table 2
Potential coping strategy options offered to respondents in Wedza District, Zimbabwe, in order to understand the perceived importance of different coping strategies under three shock scenarios. Potential coping strategies were derived from Kinsey et al. (1998), Woittiez et al. (2013), and consultation with local residents during earlier fieldwork in the same study area from April to September 2014.

1	Sell cattle
2	Sell other assets, including small livestock
3	Depend on local networks of friends and relatives
4	Depend on friends and relatives who live outside Wedza District
5	Depend on assistance from church or social groups such as savings clubs
6	Depend on aid from government or NGOs
7	Carry out piecework for other households in the local area
8	Migrate for work (one household member)
9	Leave the area (whole household)
10	Reduce consumption (e.g. cook with a smaller pot)
11	Collect environmental resources for own use or sale

2.4. Data analysis

Household responses on coping strategies used in 2002 and 2008 were coded into coping strategy categories. To determine whether observed differences in number of households using environmental coping strategies in 2002 and 2008 were statistically significant, households were coded as 1 (used environmental coping strategies) and 0 (did not report use of environmental coping strategies). A generalised linear model with binomial distribution was used for the analysis, with recalled use/non-use of

environmental coping strategies as the response and year as the categorical explanatory variable. Only households already established in the study area during the hazard exposure were included in the analysis – coping strategies of respondents living outside the study area were not included, as other parts of Zimbabwe experienced different exposure contexts in the two years. This resulted in a sample size of 64 households in 2002 and 77 households in 2008. All data analyses were carried out in Excel and R (R Core Team, 2014).

To understand the motivations behind coping strategy choice, qualitative data on the advantages and disadvantages of the various coping strategies from both recall and scenario survey components were compiled and analysed using the charting method in Laws, Harper, and Marcus (2003). Household case studies were selected for more detailed examination by identifying households which reported particularly high dependence on environmental resources in past exposures or which rated environmental resources particularly highly in scenario exercises, and related data on these households were subsequently extracted from field notes to improve case study detail. It is obviously not possible to generalise from individual households to larger populations, but these case studies serve to demonstrate how people might find themselves in a vulnerability context which creates dependence on environmental resources. We also explore whether there are differences in recalled coping strategies between the six study villages, in order to improve understanding of the links between local social-ecological context and coping strategy choice.

3. Results

3.1. Recalled responses to past hazard exposures

3.1.1. 2002 drought

While intergovernmental organisations such as the FAO painted a bleak picture in 2002 for Zimbabwe as a whole (see FAO/WFP, 2002), the majority of respondents in Wedza recalled coping with the drought exposure of 2002 as having been a relatively straightforward experience. The impacts of the drought were substantial, with only 14% of the 64 respondent households already established in Wedza District in 2002 reporting having experienced no difficulties (Fig. 1). However, respondents also recalled that at this point there were still groceries available for purchase in local shops. A household able to access money, whether through savings, pensions, work or remittances from relatives, was therefore also able to access food. Respondents also recalled substantial government and NGO activity in Wedza in 2002, with more than 20% of households remembering drawing upon government or NGO support. Many of these households described their involvement in food-for-work schemes, in which maize was provided in exchange for spending several hours a day carrying out work such as mending potholes in the roads.

Thirty-one percent of households recalled depending upon at least one environmental strategy in 2002. Gold mining/panning was the most commonly reported environmental strategy, as points of gold could either be sold for cash or bartered for food with visiting buyers. Only 11% of respondents mentioned wild foods in their recalled coping strategies for 2002. Environmental coping strategies were recalled as important by a greater proportion of respondent households in mountain adjacent villages (Table 3), with this difference largely attributable to the higher proportion of households in these villages panning or mining gold.

3.1.2. 2008 harvest failure and hyperinflation

Many respondent households recalled the double hazard exposure in 2008 creating a context which was much more challenging than the one encountered in 2002. Similarly to 2002, the majority of respondent households experienced partial or total failure of the annual maize crop in 2008, but the difference recalled by respondents in 2008 was that it was hard to compensate by purchasing food. Interviewees told stories of shops with largely empty shelves, and of spending hours in queues (sometimes even sleeping overnight outside shops) waiting for deliveries to arrive. They also recalled that there was no guarantee of success unless you were connected to one of the 'stuff people' – wealthy, well-connected local residents able to obtain products, often from relatives abroad. Several respondents recalled how shopkeepers would hide any deliveries and sell products 'from the back door' for a higher price, preferably paid in hard-to-come-by and technically illegal foreign currency. The exception to the lack of food available to purchase was in villages with gold mining concessions, where gold buyers bought in food to exchange with points of gold. Recalled dependence on government or NGOs was lower in 2008 than in 2002, with no mention of the food for work schemes prevalent in 2002. Even those who recalled receiving help from donors emphasised that NGOs did not arrive in Wedza until the end of 2008, when households had already been struggling for several months.

This more difficult vulnerability context is associated with a significant increase in the proportion of households recalling dependence upon environmental coping strategies (glm with binomial distribution; log odds increase by 0.8 between 2002 and 2008, $p = 0.02$). The proportion of households reporting dependence on gold panning was similar in 2002 and 2008, but the proportion of households recalling dependence on wild fruits more than doubled, from 11% in 2002 to 26% in 2008 (Fig. 1). In total, more than 50% of the respondent households recalled depending on at least one environmental coping strategy in 2008.

Coping strategies based on consumption of wild fruits were most prevalent in the two lowland villages, Makumbe and Pfende (Table 3). Most commonly mentioned were *hacha*, the fruit of *Parinari curatellifolia*, which can be eaten fresh or used to make sweet beer, buns or jams. Respondents recalled spending nights sleeping under *hacha* trees so that they could collect the fruit as they fell, or waking children in the small hours of the morning so that they could walk miles to villages with *hacha* trees. Several respondents even referred to 2008 as 'the *hacha* year', illustrating the importance of the fruit during the crisis.

Consumption of wild fruits was also mentioned by respondents in mountain adjacent villages, but was less commonly recalled as a primary strategy than in the two lowland villages. Gold panning was the more commonly recalled strategy particularly in Mapfanya and Mbizi, the two villages with claims to gold mining concessions on the mountain. Dependence on small-scale gold mining was particularly pronounced in Mbizi. 9 of the 12 Mbizi study households already established in 2008 recalled either having engaged in mining themselves or having taken advantage of other livelihood opportunities brought to the area by gold-mining, such as being paid by visiting buyers to store the groceries used to barter for points of gold.

3.2. Scenario exercises: perceived importance of environmental coping strategies

Environmental resources were included in anticipated coping strategy portfolios by almost all respondent households in all three hazard exposure scenarios (Fig. 2a) and were also among the strategies assigned the highest mean scores across all respondents (Fig. 2b). Other strategies commonly selected or highly scored in all three scenarios were remittances from kin living outside the study area, reducing consumption, and selling small assets such as chickens. Local networks and church support were perceived as likely to be more important following an idiosyncratic household health

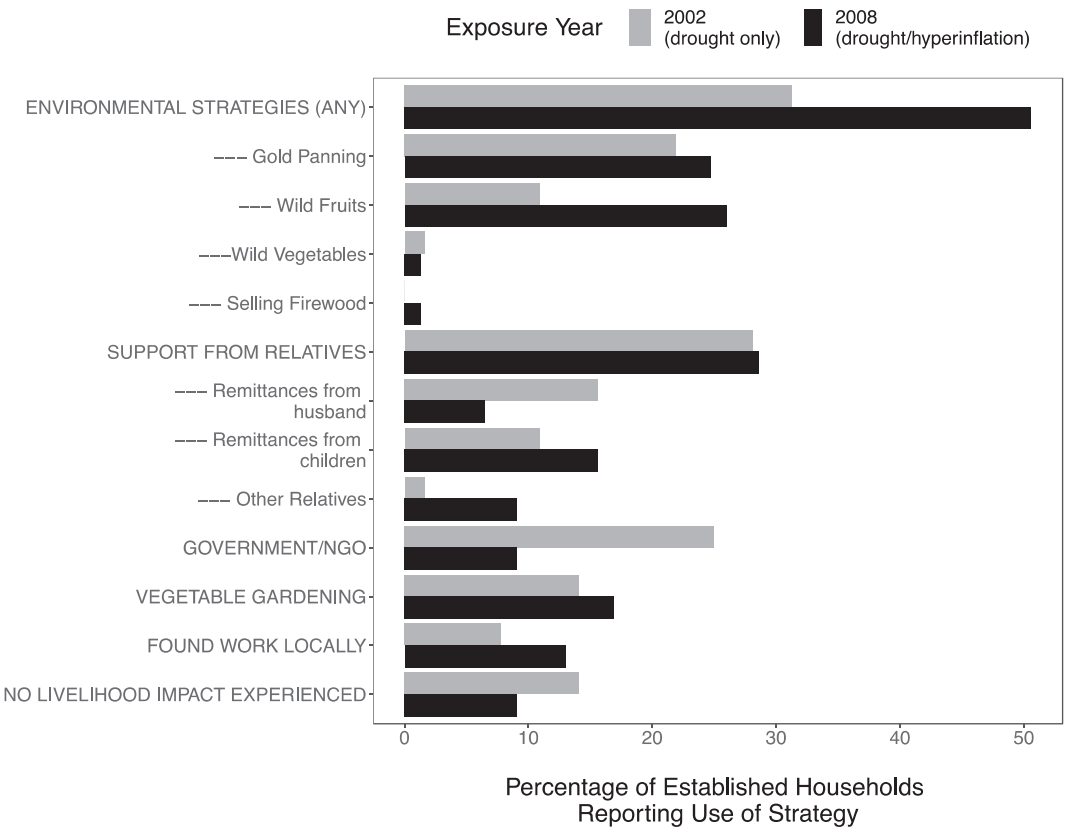

Fig. 1. Proportion of households in Wedza Communal Area reporting dependence on different coping strategies in the drought exposure of 2002 and the co-occurring harvest failure/hyperinflation exposure in 2008. Sixty-four of the total 85 respondent households were already established in 2002 and 77 respondent households were established in 2008. As coping strategies were ascertained using open-ended questions, responses should be treated as representing primary coping strategies rather than necessarily the full portfolio of coping strategies adopted during the course of the exposure. Figure includes only strategies reported by at least 10% of respondents in either year.

Table 3
Use of environmental coping strategies in 2002 and 2008 in Wedza Communal Area, Zimbabwe, disaggregated by study village.

Use of Environmental Coping Strategies in 2002						
Village	Makumbe	Pfende	Mapfanya	Betera	Charambira	Mbizi
Number of respondent households established in 2002	19	9	12	12	4	8
Households recalling use of any environmental coping strategies	2	2	6	5	1	4
Households recalling use of wild fruits	1	2	2	1	0	1
Households recalling use of gold	1	0	4	4	1	4
Use of Environmental Coping Strategies in 2008						
Village	Makumbe	Pfende	Mapfanya	Betera	Charambira	Mbizi
Number of respondent households established in 2008	19	11	16	12	7	12
Households recalling use of any environmental coping strategies	7	7	8	5	4	9
Households recalling use of wild fruits	7	6	3	3	1	0
Households recalling use of gold	0	0	5	2	3	9

shock, and government/NGO support was commonly selected only in the covariate crop failure scenario. While environmental resources and remittances from kin outside the study area were included in coping strategy portfolios by similar numbers of respondents, remittances were more often selected as a top-ranked strategy (Fig. 2c).

3.3. Why do Wedza residents depend – or not depend – on environmental coping strategies?

The most commonly mentioned advantage of environmental resources is that they require only the labour of the collector. Many alternative strategies rely upon households having access to substantial capital (following the terms used in the Sustainable Livelihoods Framework; Scoones, 1998), such as physical assets which can be sold or connections to wealthier residents with resources to share. While not non-existent, the barriers mediating access to environmental resources are easier to surmount than those for other strategies.

From the evidence of household case studies, dependence upon environmental coping strategies may sometimes be a continuous situation due to chronic lack of access to capital. This is illustrated by the examples of Mai M and Baba C. Mai M is a widow in her fifties who remained living in the study area following the death of her husband. She has no family and poor relationships with her deceased husband's relatives – among other things, she says that they are currently withholding the *lobola* (bride price) which Mai M should have received on the marriage of her daughter. She

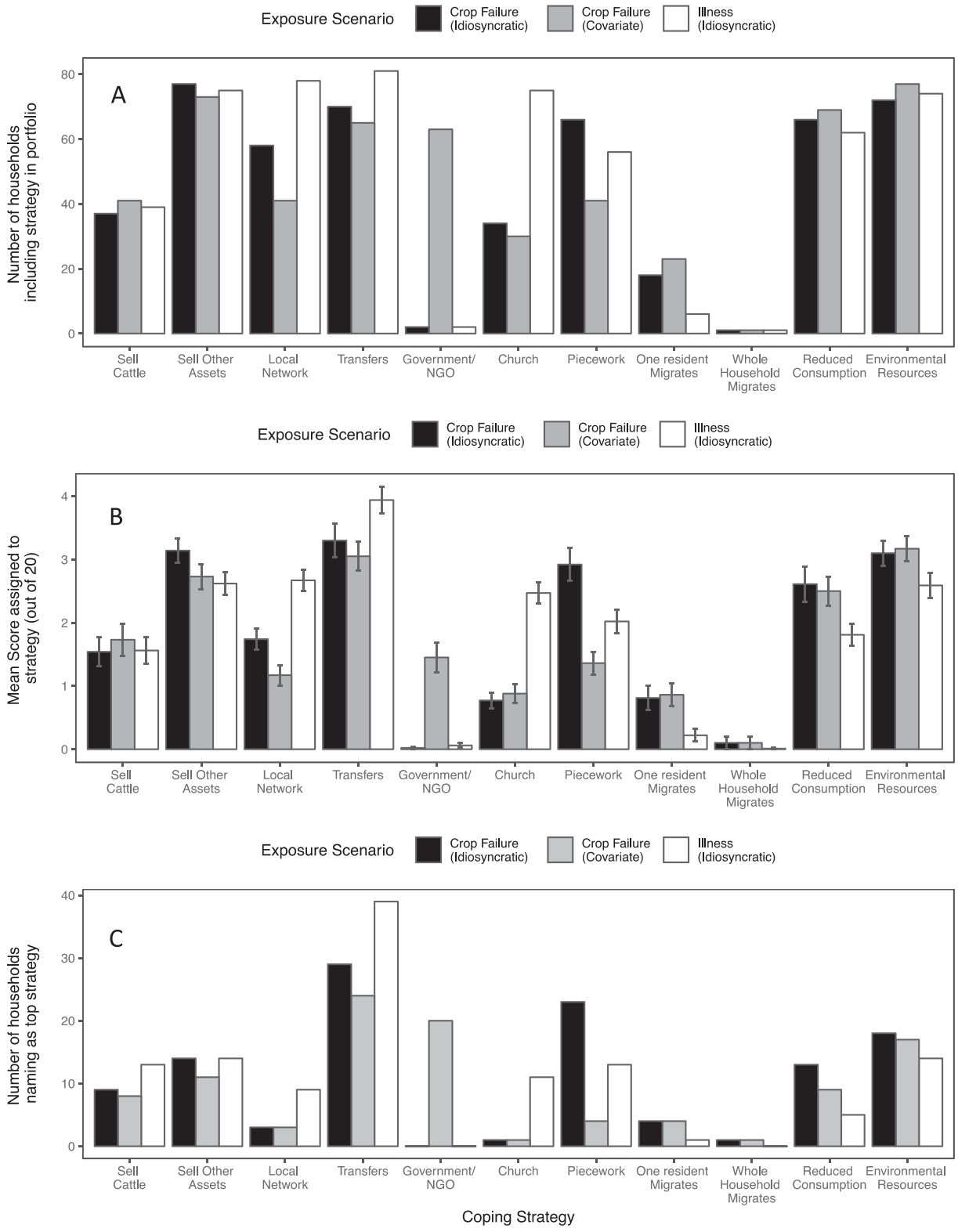

Fig. 2. Anticipated coping strategies in response to three hazard exposure scenarios in households (n = 85) in Wedza Communal Area, Zimbabwe. A) shows the number of households adopting each strategy within the predicted portfolio in response to each hazard scenario. B) shows the mean weight out of 20 assigned to each strategy option. C) shows the number of households choosing a strategy as the top-ranked or joint top-ranked strategy in response to each scenario. Error bars in B) represent ± 1 standard error.

believes that her lack of strong social connections is the reason that she rarely receives government support, saying that the village head writes the list of names and he favours his own kin. Her children are themselves not wealthy and so can provide only limited support in a crisis. In good times, she derives income primarily by doing piecework for wealthier households and by cutting thatching grass for sale. With few alternative options available, she was one of the few households recalling dependence on *hacha* in both 2002 and 2008. She anticipates that in case of illness, her lack of local support networks would mean that her only options

would be to sell her chickens and to make sweeping brooms from grass, which she could send her grandchild to Wedza Growth Point to sell.

Baba C, in contrast, has very good local support networks. He is a man in his early 40s living with his wife and one young child. His household is poor, but he is an excellent hunter – to the extent that he is sometimes pays the maintenance for his children from previous marriages in the form of cane rats and porcupines. He has strong local social capital as his mother and brothers live in the same study village and would support him if he experienced an idiosyncratic shock. However, he knows that they would have nothing to share in a covariate hazard exposure, and so he would anticipate becoming dependent on environmental resources, as he considers them to provide a better return on labour than piecework. He is not happy with his life and sees few opportunities in the village, but he does not plan to leave the area – with little education or formal training, and few strong kin connections outside Wedza, he argues that he would be equally destitute elsewhere.

Despite these examples, it would be erroneous to suggest that dependence on environmental safety nets in Wedza solely occurs amongst the chronically poor. We also encountered several respondents whose dependence on environmental safety nets resulted from the co-occurrence of an idiosyncratic hazard with a covariate exposure, rendering preferred coping strategies temporarily unavailable. One such example is Mai P, from one of the households that became dependent on wild fruits in 2008 after using other strategies in 2002. At the beginning of 2008 Mai P was still living with her husband and they lived comfortably on his pension. However, Baba P suffered from tuberculosis, and had to travel up to the town of Marondera during the financial crisis because they were having problems accessing his pension and so could not buy food or medicine. While in Marondera he became increasingly unwell and finally passed away. With no way of accessing the pension money, Mai P resorted to vegetable gardening and collecting wild fruits to support her young children. There are parallels in the accounts of two other women who were amongst the minority depending on wild fruits in 2002. Mai G had to depend on environmental resources after her husband was arrested in another part of Zimbabwe for illegal mining, while Mai T had to collect *hacha* in 2002 after the company her husband worked for in Harare ran into financial difficulties and reduced his working hours.

While environmental resources were highly rated in scenario exercises, respondents did also identify a number of disadvantages to environmental coping strategies. The first is that the labour required is substantial. Wild fruits and vegetables can be collected by most people, but collection of higher-value resources such as firewood and gold is intensive and challenging work. Strategies based around these resources are therefore often not practical for households comprising only older residents or for those with other time-heavy responsibilities such as caring for young children. The second is that collection of some environmental resources is technically illegal – the rules governing the cutting of fresh firewood in Wedza are patchily enforced, but the potential for fines is enough to deter some respondents. The third is that environmental safety nets are seen as unreliable, both in terms of supply and demand. Resources such as wild fruits are seasonal and levels of production vary, leading one respondent to say that environmental resources are collected 'by accident' rather than something to be planned around. There is also no guarantee of finding a buyer for thatching grass or firewood. The main exception to these unreliable markets is gold – during drought periods gold buyers converge on the gold mining areas of Wedza Mountain, for reasons not established during the study but perhaps hoping to make a profit by selling the gold onwards for a higher price in Harare (several survey respondents currently derive substantial income in this way). The extent of activity around the mountain led one respondent to describe the area during the drought as looking like Mbare, referencing the famously hectic township to the south of Harare known for its density of vendors.

4. Discussion

Our results demonstrate the value of environmental safety nets to rural households in Wedza Communal Area, particularly during severe covariate hazard exposures.

4.1. Interacting hazards, vulnerability context and environmental safety nets

Our research indicates that environmental resources become an important part of household strategies when the interplay between simultaneous hazard exposures renders preferred alternatives unavailable. This is illustrated firstly by the increased dependence on environmental safety nets in 2008 as opposed to 2002, which was associated with declines in the availability of support from government or NGOs and with reduced ability to purchase food in shops (the strategy used by many households in 2002 to compensate for harvest failure). It is further illustrated by the household case studies, in which the composition of household networks and changes to this composition were important influences on the likelihood of dependence on environmental coping strategies. It is widely recognised that social networks often become saturated during prolonged covariate exposures (MacLean, 2011; Vervisch, Vlassenroot, & Braeckman, 2013) and that the support provided by the network is dependent upon the resources already available within that network (Portes & Landolt, 2000) – as shown by the example of Baba C, a network of poor relations provides only limited coping potential, however strong the linkages forming the network. In two of the household case studies, it appears to be a change in the resource endowment of the extended household network due to the arrest or unemployment of the main cash income earner that resulted in dependence on kin connections becoming an unviable strategy and promoted dependence on environmental resources.

The examples in this paper show the importance of considering the broader vulnerability context when attempting to understand coping strategies, as has been argued by numerous authors (see Turner et al., 2003; O'Brien et al., 2009; Quinn et al., 2011; Bennett et al., 2016), but rarely operationalised in studies of environmental coping strategies. The higher recalled use of environmental coping strategies in 2008 was not produced by any factor in isolation, but occurred due to the interaction between multiple hazard types, local and larger-scale social-ecological contexts, and the characteristics of individuals or households. Our findings agree with those of Wunder et al. (2014) in that they suggest environmental resources (at least in the case of wild foods) to be an 'option of last resort', chosen only when other strategies are impossible. However, we differ in our interpretation of this finding. By being a strategy of last resort for vulnerable households – in some cases one of the final barriers against starvation – we suggest that environmental coping strategies are perhaps more, rather than less, important than previously perceived.

It should be noted that throughout this paper we have diverged from many similar studies (e.g. Paumgarten, 2005; Kalaba et al., 2013) by favouring the term 'environmental coping strategies' over 'forest resources' or 'non-timber forest products' (NTFPs). Our motivation for doing so lies partly in the difficulty of defining either forest or NTFP (Belcher & Vantomme, 2003; Chazdon et al., 2016). However, we also believe that such terms do not reflect the ways in which rural people in Wedza derive resources, with

many environmental resources collected from more ecologically degraded lands or cultivated land rather than from high biomass woodland. Environmental resources identified as important in coping strategies and which could be classified as NTFPs include wild fruits, wild vegetables, wild meat, firewood, thatching grass and grass sweeping brooms, although this list is unlikely to be exhaustive (see Study Limitations below). Of these, earlier research indicates that only firewood is derived solely from tree dominated land covers (Pritchard, Grundy, van der Horst & Ryan (2019)). The *hacha* fruit, so important in 2008, were often collected from large remnant trees deliberately left during agricultural clearance (Pritchard, unpublished data), while thatching grass, broom grass and wild vegetables are derived mainly from cultivated lands or seasonal wetlands. Rather than uncritically assuming environmental resources to be derived from the woodland and that initiatives such as landscape restoration will enhance rural livelihoods, it is important that landscape management interventions engage with the full complexity of resource use patterns by rural people and safeguard access to the resources important to household resilience during the process of restoration.

The observed importance of small-scale gold mining in Wedza coping strategies also merits comment. The importance of gold mining to rural livelihoods in Zimbabwe, particularly in the wake of the economic decline, has been documented by numerous authors (Kamete, 2008; Mabhena, 2012; Spiegel, 2015). Our study is a further illustration of the need to better integrate small-scale mining and mineral resource extraction into the environmental coping strategy literature, at least in Southern African contexts.

4.2. Environmental coping strategies: limitations and context dependence

While requiring less capital to access than many alternative coping strategies, environmental safety nets are not without downsides. Legal restrictions on resource collection are perceived as an important control on the collection of more lucrative resources. This echoes the observations of McSweeney (2005), who found that the forest extraction ban in Honduras following Hurricane Mitch constrained dependence on environmental resources. Other studies on environmental coping strategies have similarly highlighted the low rate of return on labour, illegality, seasonality and market unreliability associated with environmental resources (e.g. McElwee, 2008; Fisher et al., 2010).

It is important to also acknowledge the role of local social-ecological context in shaping environmental coping strategy options, as previously shown by Eriksen and Silva (2009) in Mozambique. The presence of gold deposits in the study area, and the rights held by local communities to access these deposits, will inevitably have impacted the composition of coping strategy portfolios, as will the coincidence of the peak of the 2008 exposures with the fruiting season of *Parinari curatellifolia*. The different coping strategies recalled in different villages during past exposures show how dominant strategies may vary over short distances, depending on the natural resources in close proximity. We may therefore have found different coping strategy patterns if we had focused on a different part of Zimbabwe or an exposure peaking in a different season. But this is not an argument against environmental resources being important; rather, we believe it adds weight to the need for more detailed investigation of the social-ecological vulnerability contexts which produce dependence on environmental resources.

4.3. Study limitations

The primary limitation of our study relates to the use of recall data to understand the coping strategies used in 2002 and 2008. While it was necessary to use recall of earlier hazards to understand the importance of environmental coping strategies in crisis conditions, as no hazard exposure of equivalent severity had occurred in the years immediately preceding the study, the long recall periods involved mean that we must add a note of caution to our findings. We have controlled for recall errors as far as possible by triangulating interview data with focus groups, and also by focusing only on very severe shocks which stand out in respondent memories. However, there is a need for longer term panel data recording coping strategies as they occur, in the same way that longitudinal data have been used to track changes in household assets in response to hazard exposures (see e.g. Dercon, 2004; Dercon, Hoddinott, & Woldehanna, 2005 for an example in Ethiopia). Our lack of contemporaneous data on household characteristics also means that we are not able to statistically analyse links between household characteristics such as wealth and household size with past coping strategies, as we believe that the errors associated with recalling such quantitative details after over a decade would invalidate the conclusions.

An additional limitation relates to our use of open-ended questions to understand coping strategy choice. This strategy was adopted to avoid leading respondents; however, a side-effect of this approach is that our results are likely to reflect the strategies respondents perceive to be the most important, rather than the full portfolio of strategies. Similarly, the environmental resources mentioned by respondents are likely to be those considered most important, so that resources used in lower quantities or during less critical periods of food shortage are likely to have been omitted. While still favouring the use of qualitative data to provide depth of understanding as opposed to using a quantitative questionnaire, a lesson from this research is the need to add additional structure to the conversation, for example by using a calendar and more detailed prompts to explore the nature and sequencing of the full suite of coping strategies used by a household.

A third possible constraint is that several of the environmental resources potentially used in coping strategies are illegal, specifically the cutting of fresh firewood, and this may have been underreported by respondents for fear of reprisal. We believe that the long period of time invested in trust-building in 2014 will have reduced the likelihood of underreporting, but cannot rule out the possibility that environmental resources may even by more important than documented in this study.

5. Conclusions

Our results show that, despite limitations, environmental coping strategies play an important role in the livelihoods of households coping with hazards in the Wedza area of rural Zimbabwe. Our findings demonstrate the need to consider the whole vulnerability context encountered by a household when evaluating the importance of environmental coping strategies, and to consider how this vulnerability context, and thus dependence on environmental safety nets, might be altered by the coincidence of interacting hazard exposures. We anticipate that this study will motivate further analyses in different regions exploring how different vulnerability contexts reduce or promote environmental dependence, and so improve understanding of the contribution made by environmental resources to the resilience of rural livelihoods in the face of climate change.

Conflict of interest statement

The authors listed on this paper declare that they have no conflicts of interest which could have influenced the outcomes of this research.

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Appendix A. Supplementary data

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